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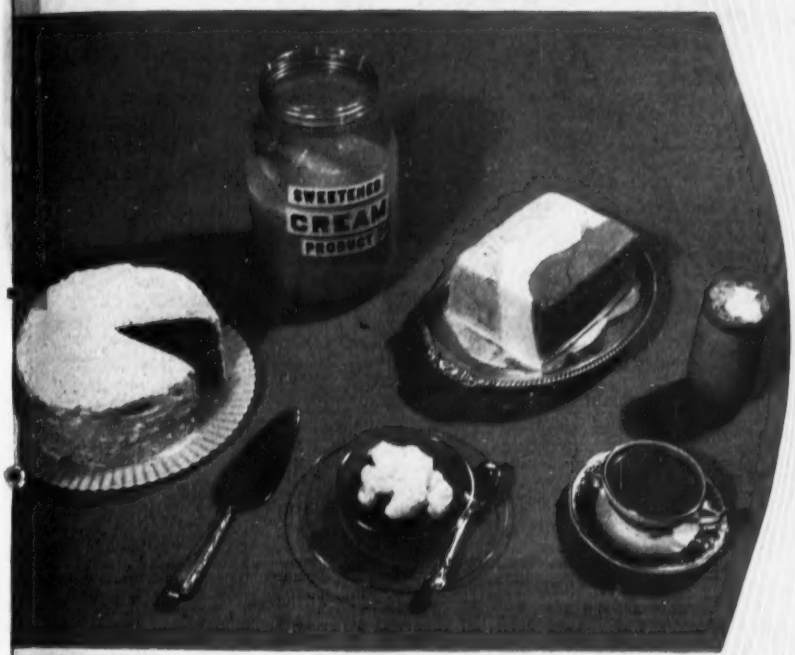

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U. S. DEPARTMENT OF AGRICULTURE

AGRICULTURAL
Research

Vol. 6—November 1957—No. 5

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For all

We eat lettuce in January without a thought. But year-round lettuce took plenty of thought by scientists. Plant breeders had to develop disease-resistant varieties. Other scientists had to find out ways of growing lettuce efficiently in both winter-crop and summer-crop areas. And they had to learn how to keep lettuce during long hauls to markets.

The same can be said of nearly everything we eat. There isn't a major crop that research hasn't improved for us.

Our point is that farmers aren't the only people to benefit from agricultural research. So do consumers.

Sure, agricultural research is done for farmers. But it benefits them only when it helps meet the needs and preferences of consumers. Farmers' gains tend to be reflected in lower prices, better quality, improved commodities or services.

Agricultural research has benefited farmers by shortening their work day and lightening their labors. It has contributed to increasing their purchasing power. It has helped bring vast improvements to farms and communities. It has elevated the dignity of farming, given farm young people better educational, social, and business opportunities.

All this farm progress has benefited the whole country. Farm labor has been released for producing other kinds of goods and services. (In some undeveloped countries, practically all the people live on farms—they have to, to raise enough food to survive. Here, only 1 person in 7 lives on a farm.) Our urban-industrial economy, with its high standard of living, could never have come about except for the research development of an efficient, technical, and specialized system of producing and marketing our farm and forest products.

So improvements in agriculture don't just happen. And research is undertaken not just because *farmers* want something better but because *consumers* want something better. To a large extent, consumers' needs and preferences set the course of research and encourage farmers to apply the results.

We've put our taxes into State and Federal research for more than a century. Past results suggest that we can look for continuing worthwhile returns on our investment.

Agricultural Research is published monthly by the Agricultural Research Service, United States Department of Agriculture, Washington 25, D. C. The printing of this publication has been approved by the Bureau of the Budget, September 16, 1955. Yearly subscription rate is $1 in the United States and countries of the Postal Union, $1.35 in other countries. Single copies are 15 cents each. Subscription orders should be sent to the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

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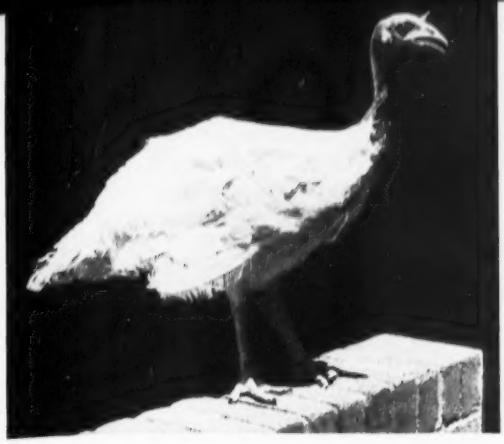

FATHERLESS TURKEY, inbred, looks normal except for dull-witted expression. Owing to bad eyesight or improper nerve coordination, bird consistently undershoots a half inch or more when pecking at food, insects. He eats well, exercises normally, sleeps a good bit. Weight is low average—13 pounds at 28 weeks. Bird has crooked toes. He isn't aggressive.

A PARTHENOGENESIS ACTIVATOR

Fowl-Pox Vaccination Increases Spontaneous Embryos

■ AN ACTIVATING AGENT may be partly responsible for parthenogenesis—spontaneous development of embryonic tissue—in eggs of nonmated turkeys and chickens, USDA studies show (AGR. RES., June 1956, p. 3).

Three-year incubation tests (1955–57) showed greater parthenogenetic cell development in eggs from turkeys and chickens vaccinated for fowl pox than in eggs from the same birds before vaccination. ARS poultry scientist M. W. Olsen isn't sure whether the activating agent is the vaccine or a contaminant it may contain.

Partially responsible for this increase, too, is the fact that tested birds belonged to a strain found to be more susceptible to parthenogenesis. The combination of these two factors—activating agent and genetic susceptibility—gives rise not only to more cases of parthenogenesis but also to a more highly organized type of development in affected eggs.

Selection affects tendency

Work at the Agricultural Research Center, Beltsville, Md., indicates that the tendency towards parthenogenesis can be increased or decreased by selective breeding. Certain families of chickens and turkeys getting the same vaccination treatment differed widely in their ability to produce parthenogenetic eggs. The same is true of individual birds.

First indications that a virus might be involved in triggering parthenogenesis came in a 1955 test of eggs produced by virgin Dark Cornish pullets. More than three times as much parthenogenetic development was seen in eggs produced by test birds after vaccination for fowl pox than in eggs laid by the same birds before vaccination. Incubation tests since then confirmed these results.

Vaccination increases rate

Vaccination for pigeon pox, involving a milder virus, also resulted in increased parthenogenesis. But the rate was not nearly so great as that after fowl pox vaccination.

Of the 738 eggs produced by 16 nonvaccinated turkeys during the 1956 tests, 180 or 24 percent showed parthenogentic development after 9 to 10 days of incubation. The 49 vaccinated turkeys produced 2,362 eggs, of which 750 or nearly 32 percent showed parthenogenesis.

In the 1957 tests (concluded in June), 130 vaccinated birds laid 6,547 eggs, of which 2,466 or 38 percent were parthenogenetic. The 42 nonvaccinated birds laid 1,767 eggs, of which 559 or 31 percent showed such spontaneous development.

In all cases, eggs produced by vaccinated turkeys developed a higher ratio of well-formed embryos than eggs from nonvaccinated birds.

Olsen also noted that the vaccination history of the mothers was related to the performance of their nonvaccinated daughters. Nonvaccinated turkeys from mothers vaccinated only once produced fewer eggs that developed parthenogenetically than did nonvaccinated females from mothers vaccinated three times. The latter progeny produced twice as many eggs showing blood formation and nearly five times more embryos.

The fact that there is some parthenogenesis in nonvaccinated hens from vaccinated parents also seems to indicate that the activating factor, whatever its nature, is passed from mother to daughter through the egg. Daughters of nonvaccinated hens are being raised to test this further.

Chickens not as susceptible

Parthenogenesis is far less marked in chickens than turkeys. Thus far, no chicks known to be parthenogenetic have hatched. And only two such embryos have been found in the thousands of chicken eggs examined. In several cases, parthenogenetic turkey eggs produced poults that hatched and lived for more than a few days—one lived for 22 days, one for 18, one for 41, and one is still alive at 198 days (October 8).

These studies on parthenogenesis are providing basic information on problems of poultry fertility and hatchability, of critical importance to turkey producers, and on fundamentals of cell development, significant for research on cell growth in all forms of life. This work is also giving us knowledge essential for better understanding poultry physiology. ☆

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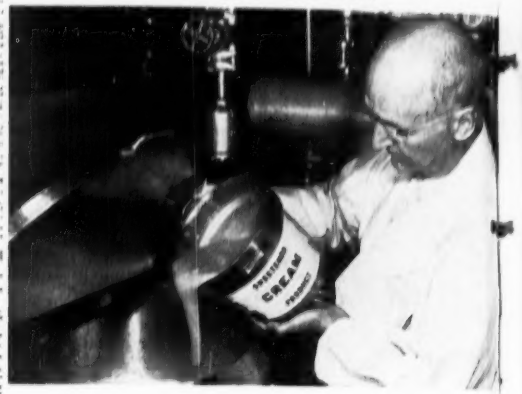
sweetened cream looks promising

This sugar-preserved product is easy to make and store, has numerous uses



GOLDEN colored cream product is poured into ice cream mix by R. W. Bell. Greatest potential use is in ice cream manufacture. Sweetened cream stores easily in 5-gallon containers at 60° or 70° F., takes flavors very readily.

FLUFFY topping for desserts may be made with modified sweetened cream. It's good on cakes, fruit, flavored drinks (see cover). Commercial potential of new product hasn't been explored thoroughly. Other applications may exist.

■ GREAT PROMISE is shown by a new dairy product—modified sweetened cream. It's easily made, can be stored at room temperature (70° F.) up to 6 months and still taste good. The product was developed by USDA and can serve a wide variety of purposes where a source of fat, sugar, and nonfat milk solids is needed.

Biggest potential use for the new product is in ice cream manufacture, replacing the frozen cream or other source of milk fat now used. Cream is expensive to freeze (this adds to the cost of ice cream) and takes up costly refrigerated storage space.

Commercial, home use seen

Sweetened cream whips into a light, frothy topping for fruit, cakes, and pies. It could be used in candy, pastries, and other baked goods, in cake icings, and flavored drinks. Or it could be diluted for a single source of cream and sugar for coffee and cereals in homes, restaurants, and on camping trips. It has been successfully caramelized. The product lends itself to use in the armed forces, and on planes and ships—wherever refrigeration space is not available.

The product contains about 40 percent fat, 30 percent sugar, 20 percent water, and 10 percent nonfat milk solids. Fat content is approximately five times that of sweetened condensed milk and twice that of coffee cream. Composition can vary, depending on intended use. Preservative action of the sugar keeps it from spoiling, just as jams and jellies keep because of their very high sugar content.

The product is simply prepared and requires little equipment—a centrifuge to separate cream from milk, and facilities for pasteurizing before packaging. High-fat cream can be obtained by heating after the first separation, then separating again to increase fat to the desired level.

Homogenization may be necessary for some applications, but its advantages may offset the added cost and time. This step prevents fat separation (unprotected fat on and near the top may oxidize if not homogenized), permits control of lactose crystallization, and decreases tendency to churn when whipped. The cream product can be homogenized immediately before or after pasteurization.

Storability important asset

For best storage, sweetened cream should be packed in sealed tin cans or glass jars. Vacuum packing is desirable but not necessary. (Oxidation deteriorates fat, so it's obvious that the product will keep better and longer if air is excluded.)

So far, it has been successfully stored for 6 months at 70° F. Tests show that it can be stored longer at 60° F. After opening, the product lasts a week or more at room temperature, longer if refrigerated.

The product is similar in viscosity and appearance to sweetened condensed milk. It thickens and browns at high storage temperatures in the same way, too, but to a lesser extent.

It isn't as sweet, however, since it contains more milk solids, less sugar.

ARS chemist Arjen Tamsma and dairy manufacturing technologist R. W. Bell, of the Eastern Utilization Research and Development Division, Philadelphia, are developing the product. Application for a public service patent has been made by USDA.

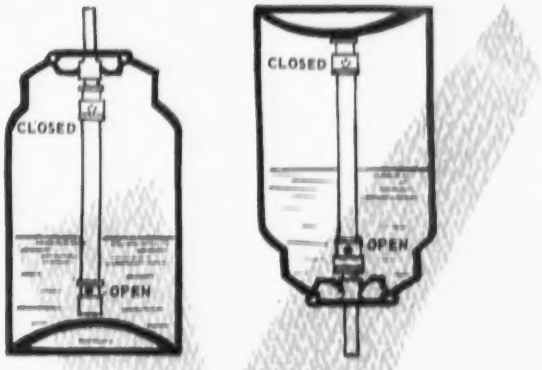
Research is still underway on the viscosity, color, flavor changes at various storage temperatures, and the shelf life of sweetened cream.

Job of development remains

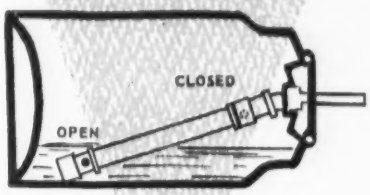
Scientists point out that they have tested this product's commercial potential in a very limited way in the laboratory. They haven't developed recipes, large-scale manufacturing methods, commercial packaging techniques, or many everyday uses.

Millions of pounds of milk fat are preserved each year as frozen cream, most of it going into ice cream manufacture. The new product could provide a simple and inexpensive way to preserve milk fat from a period of surplus to one of scarcity. ☆

SIMPLICITY of preparation is feature of sweetened cream. Product could even be prepared in home. Proper parts of nonfat milk solids, sugar are added to high-fat cream; mixture is pasteurized, packed.



ALWAYS-READY AEROSOL



■ SOME AEROSOL CANS MUST be held right side up to function. Others must be turned upside down. But now USDA has improved the original designs. Aerosol containers may be used in any position. And the dispenser tube draws the last drop. None of the solution is wasted.

USDA, whose scientists originated aerosol bombs, has applied for a public patent to make the new design available to manufacturers.

Farmers, housewives, and manufacturers can thank ARS chemist R. A. Fulton's observing eyes, which work overtime. He was repairing the washing machine at home one week end, when he noticed a sliding valve controlling the opening and closing of the water outlet. This is the same principle, thought Fulton, as a steam locomotive piston, which goes back and forth, opening and closing the steam valve.

So he made a dispenser tube of stainless steel and drilled a hole at each end. Then he fitted over each end a sliding porthole to open or close the hole in the tube, depending on the position of the can. (A glass bead may also be used inside each end of the tube to open or close the hole.) The tube can be copper, steel, or tin-coated steel, depending upon the solution. Polyethylene or nylon may also be used.

Now, no matter in what position the can is held, there will always be a discharge of the product—not the gas. Insecticides, paints, and shaving cream will no longer be wasted because of accidental discharge of gas, which makes it impossible to use the rest of the material.

The present aerosol can has a tube with an opening at one end. Space- or surface-coating products are used right side up, with the gas pressure at the top of the container. If the can is turned upside down, the gas escapes when the operator presses down on the valve. The foam type product is turned upside down to spray, with the gas at the bottom of the can. If operated right side up, gas will escape. ☆

now—a milk-solids TEST KIT

Simple, portable equipment enables scientists to undertake new work on the increasingly important nonfat solids

■ WE'RE CLOSER NOW to extensive research on production of the essential nonfat food constituents of milk. Reason: Development of a portable testing kit to measure total solids content of small samples. This is used in conjunction with the well-known Babcock test for butterfat.

Designed and improved by USDA dairy scientists, the equipment is seen as useful for fundamental research under field conditions. The kit is being used in eight cooperative Federal-State breeding and management experiments in Louisiana, Michigan, Minnesota, Tennessee, Virginia, and Wisconsin to determine its value as a research tool. There is also the prospect that the method may become the basis for expanded cooperative research involving several States and the Province of Ontario.

Consumer interest is increasing in milk's solids-other-than-fat. Among them are protein, lactose, casein, albumin, sugar, and several minerals—all having a place in the human diet. In addition, some of these are in demand for industrial use.

Research drawback removed

For these reasons, dairy researchers and the milk industry have contemplated the possibility of breeding strains of animals that would produce milk of the greatest all-round food value. But portable equipment needed to measure nonfat solids has not been available—except under laboratory conditions—for accurately evaluating progress. This lack has not only handicapped breeding work that might have been undertaken to produce more desirable animals but has also held up studies needed to determine the effect of inheritance, environment, and nutrition on the nonfat solids content of milk itself.

The lactometer has long been used to determine total solids in milk. But its use has been largely restricted to the laboratory. USDA dairy chemist P. D. Watson devised a lactometer requiring only 3 to 4 ounces of milk for each test. He then developed for use with this lactometer a mathematical formula by which the percentage of

EACH MILK SAMPLE is poured in separate cylinder, placed in this tank. Water in tank is electrically heated to 102° F.—approximately cow's normal body temperature—and held. Testing begins when milk reaches this temperature (lactometer calibrations, calculation formula are adjusted to each other at 102° F.). Tank holds 45 samples.

TESTS ARE MADE by placing lactometer—stem up—in cylinder of milk and reading calibration on stem at top of meniscus. Previously calculated formula is applied to this reading to determine percentage of total solids. Butterfat (obtained by Babcock test) is subtracted to get nonfat solids content.

milk solids can be determined more accurately. For accuracy, too, both lactometer and formula were adjusted to a temperature of 102° F., at which milk fat is in a liquid state. Accessories needed for convenience of operation and portability were designed by ARS dairy technologist F. M. Grant, working at the Agricultural Research Center, Beltsville, Md.

Test equipment easy to use

The lactometer in the kit is an elongated glass bulb weighted at the bottom so it will float upright. It is fitted at the top with a thermometer-like stem calibrated to measure the specific gravity of milk of varying solids content. A rectangular tank is used to heat water by electricity under thermostatic control. The tank is fitted with a removable rack containing 45 holes for small, cylinder-like containers of milk to be brought to the right temperature for testing.

Test results (see photos)—minus butterfat percentage as determined by the Babcock test—provide the nonfat solids percentage of a sample.

In tests for accuracy, the new small lactometer has given results satisfactorily comparable to those obtained with large lactometers and with gravimetric determinations. It has proved as reliable for nonfat solids content as the Babcock test is for butterfat content. The initial tests for accuracy were made by Federal and State dairy scientists at Beltsville, Michigan State University, University of Wisconsin, and Virginia Polytechnic Institute.

Cooperative work is planned

Potentialities of the device were discussed at a symposium sponsored by American Dairy Science Association. A committee of this organization is laying plans for interstate cooperation in studying milk quality on the basis of variations in nonfat solids as they may be influenced by climate, environment, heredity, and the like. ☆

PLANES CAN FIGHT FIRE

■ AN OLD TOOL—THE AIRPLANE—has been converted to a new use by USDA's Forest Service. Planes for spraying crops have been equipped for bulk drops of water and sodium calcium borate to fight fires. Navy torpedo bombers (declared obsolete) and helicopters also are used.

These air firefighters do not work alone. The planes cannot make drops in winds over 30 miles per hour, or at night. Nor are they effective when fires are at the bottom of steep canyons or other inaccessible places. Aircraft cannot cool down hot fires in heavy timber.

They do provide first aid, however, just as an ambulance attendant administers emergency treatment before a doctor appears. The air attack confines fires to smaller areas by dropping a chemical fireline or fence around the flames. This prevents large-scale spreading. Planes help fight the spot fires that may occur outside of established firelines. Ground crews often cannot reach there in time.

Gains are made fast by air—prompt action often helps ground crews win a nip-and-tuck battle. These men must recognize critical changes in fire behavior and take full advantage of air aid. They must concentrate on flames within the chemical fire fence or gains may be lost.

Statistically, 95 percent of the fires are held small by ground crews, compared with 75 percent 20 years ago. But the 5 percent not quickly put out cause 90 percent of the damage. Elimination of as many of the 5 percent as possible, with help from planes, is the goal.

Airplanes have long been used for transportation of men and equipment to airports or heliports near fires. They have provided short-range transportation to the immediate fire area. Airborne photographers and guides have mapped ground attacks with prevention flights.

This is the first time planes have been used directly against fire. Helicopters shuttle 40-gallon loads of sodium calcium borate from the water base to the fire. Spray planes, available on standby orders during off seasons, carry 150 gallons. And navy torpedo bombers haul up to 600 gallons, working from as much as 50 miles away.

USDA and California foresters are cooperatively trying to develop new techniques as well as standard operating methods. These researchers are studying costs and how to reach fires before they get large. They want to know more about the merits of different sizes and types of planes. Fire fighters need more guidance on just how much sodium calcium borate is required on different fuel types and densities.

Equipment is needed to simplify and speed the mixing of chemical materials for ground and air tankers. Conventional pumps and nozzles are not satisfactory for slurry-type mixtures. The most promising solution seems to be the injector type of mixer that's now being tested. Possibly, the chemical may be expelled by gas or rocket power. ☆

LABOR-SAVING way gets honey out without spoiling combs for reuse by bees (see picture at far right).

Engineers are making progress in their efforts to help this vital industry cut its high labor requirements and enable beekeepers to . . .

keep bees with ease

■ SOME OF THE GREAT labor requirement in beekeeping, an industry that's vital to pollination of fruit and seed crops, is being eliminated by engineering research.

Studies by USDA and cooperating State experiment stations have yielded important man-hour savings in both hive handling and honey extraction. Engineers are making contributions to the general thriftness and well-being of bee colonies by protecting them from extremes of winter cold and intensive summer heat. They're investigating other aspects of apiary management to help beekeepers.

Beekeeping has one of the highest labor requirements in the entire field of agriculture. In the unfavorable market of 1954, it took 52 hours of labor to produce $100 of product, and in the following year of better prices, 41 hours per $100 of product. Only tobacco, milk, and cotton production have higher ratios of labor to value.

Hive lifting and comb uncapping eased

Two-queen hives, stacked high with supers (extra sections for honey storage), are common today. Working such stacks takes much energy and time. ARS agricultural engineers C. D. Owens and B. I. Detroy and entomologist C. L. Farrar, of the Wisconsin Agricultural Experiment Station, at Madison, devised four ways to lift and tip hives on their sides for easy access. They utilized such available devices as truck and tractor fork lifts and truck hydraulic tail gates as potential sources of power.

Uncapping combs and extracting honey from them also are time-consuming bottlenecks in apiary operation. Honey and wax removed from the comb during uncapping become mixed, and removing that wax is another tedious job. The engineers have improved these operations.

Extracting, heating, cooling improved

Two nuisances in extracting honey—regulating the speed of the common radial extractor by hand, and frequent comb breakage from its accelerating too rapidly—have been eliminated by a new speed-control device.

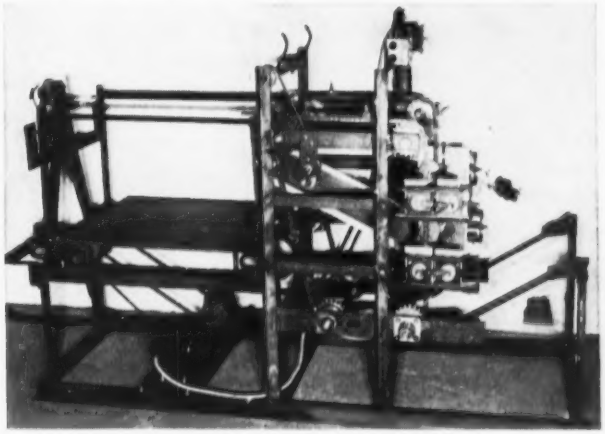
The engineering studies originally dealt with requirements of electric heaters to keep colonies in good strength under low winter temperatures in the North. A flexible, rubber-covered heating tape wrapped around the hive proved satisfactory. A positive relationship has been found between size, shape, and movement of the bee cluster, and hive temperature. Owens found that a temperature of 30° F. is preferable to 35° to 55°, and that other colony factors are important.

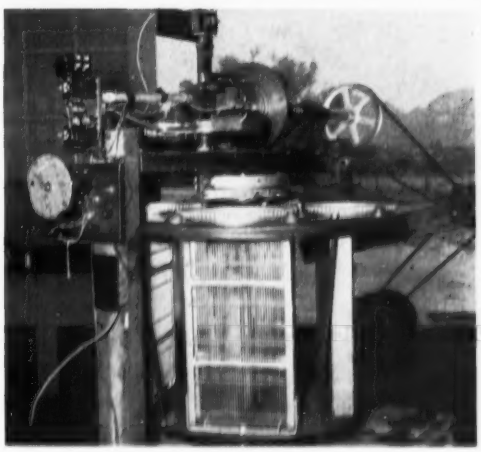
Owens is now experimenting with ways of reducing excessive heat from the Southwest summer sun. Overheat is particularly a problem in moving colonies from shaded yards to unshaded fields for crop pollination.

Other engineering studies are being made to improve the methods of storing honey in the apiary and ways of keeping honey houses in a sanitary condition. ☆

WORKING HIVES, tiresome chore in apiaries, is easy with this tricycle lifter-tilter, which puts colony on its side for examination and comb removal. Other lifters devised by USDA use truck hydraulic tail gates or tractor lifts as source of power for large-scale handling.

NEW UNCAPPER moves 20 combs per minute between two pairs of heated perforating rollers having different-sized teeth. All cells are opened neatly so bees will refill them. Machine keeps wax out of honey—an old problem. Frames move upward through rolls, across top, to dumper, and into tub.

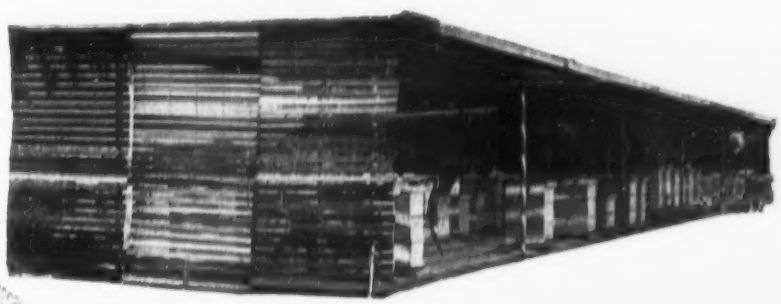


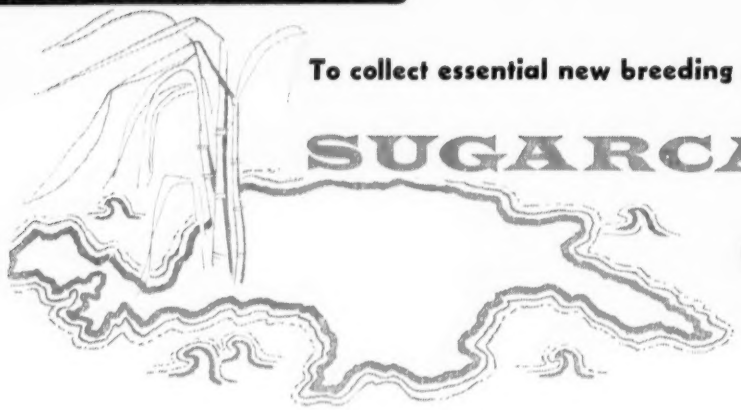


RADIAL EXTRACTOR used in Southwest has been equipped with variable-voltage speed control and timer (left, top). They brake rotor, reverse direction of basket at proper rate. This eliminates hand control and much comb breakage.

FLEXIBLE WRAP-AROUND electrical tape was easiest, best hive warmer tried for cold areas. Bees survived best at 30° F. (recorders in tubes). Actually, higher temperatures did more harm to strong, vigorous colonies than temperatures below 30° F.

ARTIFICIAL SHADES (ramadas) were long used in Southwest apiaries with knowledge of their value. ARS is studying effect of aluminum-sheet, camouflage-net, utility-fence shades on comb melting and honey yield.





To collect essential new breeding materials . . .

SUGARCANE calls on the South Pacific

■ POSSIBLE NEW COMMERCIAL varieties of sugarcane and stronger defenses against its diseases in this country may result from a USDA plant exploration trip to the South Pacific.

Carl Grassl, ARS botanist and sugarcane breeder, returned last July from a 5-month search for new germ plasm in New Guinea and surrounding islands. He and John Warner, Hawaiian Sugar Planters' Association plant breeder, sent back cuttings of 150 varieties of *Saccharum officinarum*, or "chewing canes"; 25 strains of *Saccharum edule*, canes with an edible, cauliflower-like head; and 40 varieties of *Saccharum robustum*, a wild ancestor of sugarcane.

In addition, they made 61 seed collections of *Saccharum robustum* and *spontaneum* and gathered 40 species of related wild grasses during the first expedition of its kind sponsored by this country since 1928. Both cuttings and seed were gathered; the former can be collected from exceptional plants not in fruit, whereas the latter yield a more representative sample of available genotypes.

Search covers many islands

Most cuttings and seed were collected from the Australian part of New Guinea. Special search was made in the Sepik River drainage area and the mountainous interior. Short trips also were made to many different rivers and native gardens in scattered parts of Dutch New Guinea and the British Solomon Islands.

With this substantial deposit in USDA's world collection of sugarcane at Canal Point, Fla., scientists plan to expand studies involving the breeding and selection of better adapted, higher-producing varieties possessing a higher sugar content, or other desired characteristics.

Addition of this important germ plasm to the collection will also expedite long-range research efforts to breed new varieties resistant to insect damage and to costly diseases such as mosaic, red rot, root rot, ratoon stunt-

NATIVE GARDEN in background yielded cuttings of *Saccharum officinarum*, or "chewing canes." Such gardens are fast disappearing as civilization advances in New Guinea and surrounding areas.

OPEN GRASSLAND near Port Moresby in the Australian sector of New Guinea is dotted with patches of *Saccharum spontaneum*. Collections will prove valuable in developing new sugarcane varieties.

WILD ANCESTOR of sugarcane is this *Saccharum robustum*. It grows to height of 20 feet in natural habitat along banks of Ramu, other rivers in New Guinea.

ing disease, and others. Ratoon stunting disease, for example, reduces the number and size of millable stocks. It alone accounts for an average annual loss of about 20 percent of the sugar and sirup production from sugarcane plantings in Louisiana, Florida, Mississippi, Alabama, Georgia, Hawaii, and Puerto Rico.

Sugarcane varieties have tended for many years to "run out." Scientists have attempted to cope with this problem by providing a flow of new, vigorous, high-yielding varieties. But this has succeeded only in temporarily checking the ravaging effects of several diseases that have become serious hazards from a buildup of infectious material or through rapid mutation. For this reason, a larger supply of germ plasm was necessary for conducting future research.

Native sources disappearing

This recent collection is highly important to the sugar cane industry of the world, say ARS specialists, in view of the fact that native sugarcane gardens are rapidly disappearing with the advance of civilization in New Guinea and surrounding areas.

Those cooperating in the latest exploration for sugarcane germ plasm also included representatives of the Bureau of Sugar Experiment Station, Queensland, and the Australian, British, and Dutch Governments. ☆

New Hormone

what's its future?

■ A NEW ESTROGEN—A TYPE OF HORMONE regulating specific growth activities—has been isolated from Ladino clover and its structure determined by USDA scientists. This potentially valuable estrogen—named coumestrol—is also present in alfalfa and strawberry clover.

Estrogens occur naturally in animals and plants, and they may also be synthesized. Stilbestrol, for example, is a useful synthetic estrogen used to promote faster weight gains in feeder cattle and poultry. Synthetic estrogens are valuable also in human medicine.

Animal estrogens are secreted by the ovaries and are associated with female sex development. Considerably less is known at present, however, about the character and function of estrogens in plants.

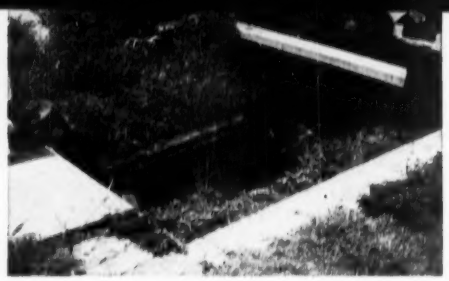
Researchers at the ARS Western Utilization Research and Development Division, Albany, Calif., report that coumestrol is different in chemical structure from other known animal and plant estrogens. Although estrogenic compounds are known to be active in about 40 plants, only a handful of these plant hormones have been isolated so far.

Coumestrol is a crystalline substance about 30 times more active than genistein, one of the most potent estrogens in forage crops. Coumestrol is less powerful in its effects on animals than stilbestrol.

When estrogens are put into livestock rations, they may have either good or bad effects, depending upon how much is used. If animals feed or graze on a forage that contains excess estrogens (or simply consume too much of a normally estrogenic forage), decreased fertility may result—even stillbirths or early death of their young.

Estrogenic activity interfered dramatically with normal fertility among sheep in western Australia during the 1940's. Cause of this decline in fertility was at first not understood but was later traced to excess intake of clover estrogen. This was due to wartime shortages of fertilizers and bulk feeds, and scanty rainfall, causing a greater than normal consumption of clover for a long period of time in that country.

Estrogen behavior in plants is just beginning to come under systematic scientific study. Recent work at Indiana Agricultural Experiment Station, for example, showed wide variations in estrogen concentrations in alfalfa during the growing season. Work also showed alfalfa leaves have more estrogen than the flowers, and flowers more than the stem. Alfalfa silage made with blackstrap molasses contains more estrogen than alfalfa in pasture or alfalfa ensiled without the molasses. ☆

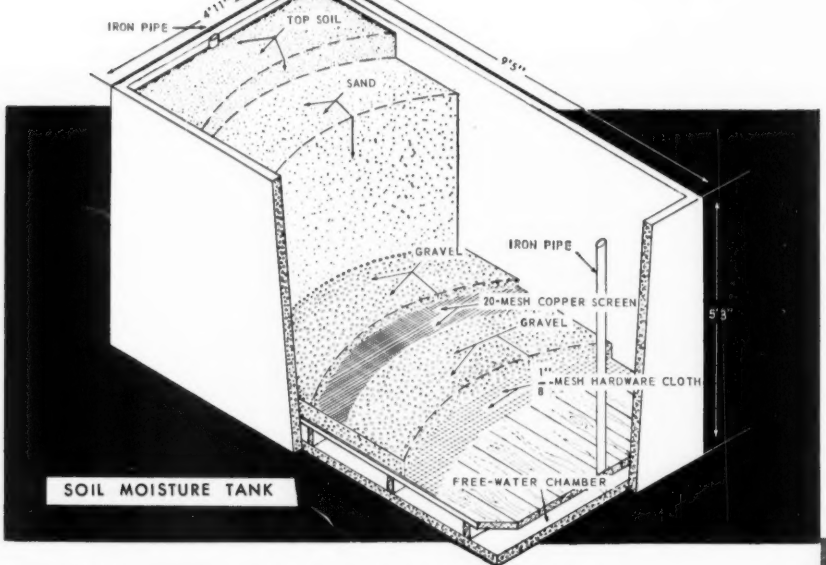


ROADSIDE CANALS are two-way link supplying water to farms at times, to reservoirs at others. Fort Lauderdale station pumped enough water in 1956 to cover 67 tilled acres 50 feet deep; this held water table up 2 feet below surface, offset 13-inch rain shortage plus usual winter drought.

managing water in flood and drought

Too much one season—too little the next—calls for research on handling drainage, water table

WATER PUMPED from canal shown at top of page will raise water level in this ditch and, in turn, penetrate porous soil to same level in bordering fields. Lowering water level in ditch would drain surplus from field.



DESIGN OF LYSIMETERS shows in cutaway drawing. Four feet of soil was assembled, layer for layer as it occurred naturally, in 12 concrete tanks at Fort Lauderdale to provide 0.001-acre plots for growing plants on regulated water table. Gravel layers at bottom, water chamber beneath, assure uniform penetration of water in soil and access for sampling or adjusting soil water.

■ FLORIDA—WITH WATER on three sides and crowding the surface for much of the year—still must overcome water scarcities at other seasons to maintain a prosperous agriculture.

Any area with a flood-drought complex can learn from studies in which USDA, Florida Agricultural Experiment Station, and Central and Southern Florida Flood Control District are jointly helping Florida overcome its paradoxical water problem.

A total annual rainfall of 53 inches may be ideal for year-round farming, but two-thirds of peninsular Florida's 53 inches comes during summer and fall, and only a third in winter and spring. There's an oversupply with storms and floods in the relatively nonproductive hot season. Then the water table subsides beyond reach of shallow-rooted winter and spring vegetables—some of the most important crops grown in the area.

To farm in this situation means growing crops over free-standing water that may range from a few inches to several feet below ground surface. It calls for keeping that water table between the highest and lowest levels tolerated by the crop. That means moving water off the farms one season and back the next—pumping both ways. Research on

DEPTH OF WATER in standpipe is checked by W. H. Speir. He daily replaces water lost by evapo-transpiration, or pumps out rain surplus. Mercury tensiometer (center) shows soil moisture; electrical conductivity instruments weren't as reliable. Topsoil temperature is recorded daily.

water tolerances and use by different crops is underway at the State's Plantation Field Laboratory, Fort Lauderdale, and Everglades station, Belle Glade. It should help crop efficiently and control water economically.

To study plant requirements and tolerances, ARS hydraulic engineer J. C. Stephens and associates built concrete soil tanks (lysimeters) at Fort Lauderdale and Belle Glade for testing plant growth at various controlled water tables. Sweet peppers, bush beans, field corn, and St. Augustine grass—important crops on the sandy and muck soils of central and south Florida—were grown on the tanks at water tables of 1 to 3 feet.

Work reveals moisture need

Water use has been found in terms of evapo-transpiration—evaporation from the soil and transpiration from the plants. That's a guide in preparing for ample drainage in times of surplus ground water and for ample irrigation in times of shortages.

Water table greatly affects water use. Mature, healthy peppers on the tanks took 0.26 inch of water daily with the water table at 1 foot, 0.21 inch at 1½ feet, and 0.22 inch at 2 feet. Greater water use was due to high surface evaporation on the 1-foot table, but to rank growth on the 2-foot table. Note that fallow soil with water at 3 feet has only 20 percent of the water loss of open lakes; with water at 2 feet, 60 percent; but with water at 1 foot, about 100 percent.

Under Fort Lauderdale's winter and spring climate, most crops grow best in a 10- to 12-percent moisture medium. That means water standing at about 2 feet below ground surface in those sandy soils. Bush beans, for example, grown on water tables of 1, 1½, 2, 2½, and 3 feet produced 2,900, 4,700, 7,000, and 2,500 pounds per acre, respectively. And the percentages of those yields grading US 1 were 35, 39, 48, 36, and 9 percent, respectively.

Similarly, fall corn grown on water tables of 1, 2, and 3 feet and variably from 1 to 3 feet produced 88 bushels (badly lodged), and 91, 69, and 83 bushels per acre, respectively, and used 17.8, 12.8, 8.8, and 10.5 inches of water. A spring crop of corn showed corresponding results.

Effect of water table noted

Sweet peppers also yielded most and the highest proportion of Fancy and US 1 grade peppers on a 2-foot water table, although they started out better on a 1-foot water table.

Water table affects soil temperature. The higher the water the cooler the root zone. State experiment station agronomist F. T. Boyd and agricultural engineer D. S. Harrison think this needs extensive study. For example, the cooling effect of a 1-foot water table helps Dallis grass in summer and hinders it in winter. Boyd suspects there's some connection with root diseases, which greatly limit a farmer's choice of crops to grow.

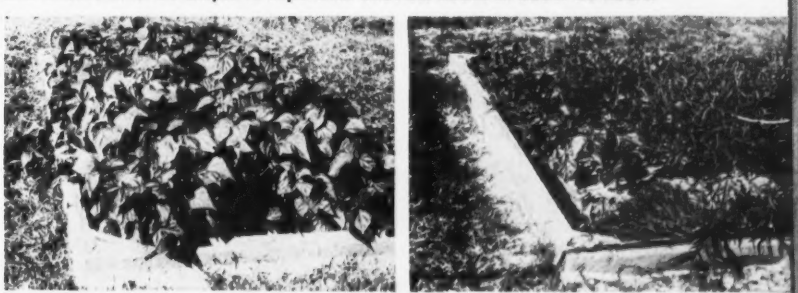
Sprinkling, flooding studied

Subirrigation is the rule in Florida, but under extreme drought, sprinkler irrigation of potatoes after sidedressing with fertilizer boosted total yields 35 to 40 percent and fancy-grade yield 45 to 50 percent. Sprinkling apparently redistributed excesses of fertilizers from the upper soil through the full depth of the root zone.

Florida farmers must expect floods and be prepared to remove water from their fields quickly enough to prevent crop damage. Stephens and his associates have studied this matter, too. They believe designs can reasonably allow, as a calculated risk, for submersion of vigorous healthy truck crops up to 36 hours. But disease-weakened plants won't tolerate submersion for even 12 hours. ☆

BEANS GREW WELL, yielded 2,259 grams of pods on tank at left, which had water table kept 24 inches below ground surface. But beans on other tank, with water at 36 inches below surface, yielded only 455 grams. Not enough moisture rises to root zone from 36-inch depth in sandy soils.

VIGOROUS BEANS TOLERATE 36 hours of submersion without injury, as shown in planting (left, below), which recovered completely and bore normal crop of pods. That was about the limit, however; few plants in other plot survived flooding for 48 hours. Grass took over. Pumps and ditches must be ample to cope with heaviest floods in about 36 hours.



How To Store Bulbs for Good Blooms

TO BREAK HABIT of slow development and late bloom, Eastern lily bulbs must be cool-stored at 45° to 50° F. for 6 weeks just before planting. These bulbs (in order from left) were kept at 50° F. for 0, 2, 4, 6, 8, 10 weeks.

Changes during the transitional bulb stages of a plant influence the way it grows and flowers

■ STORAGE ENVIRONMENT for bulbs from harvest to planting time has a lot to do with the flowering of tulips, Easter lilies, and iris. USDA research indicates that storage conditions determine whether plants will bloom and when, even (in the case of tulips) how long the stems will be.

The bulb is a plant in transition. Physiological changes in that stage will determine what the adulthood will be like. Storage temperature conditions the life processes at this period—some for good and some for bad, in the flower grower's view.

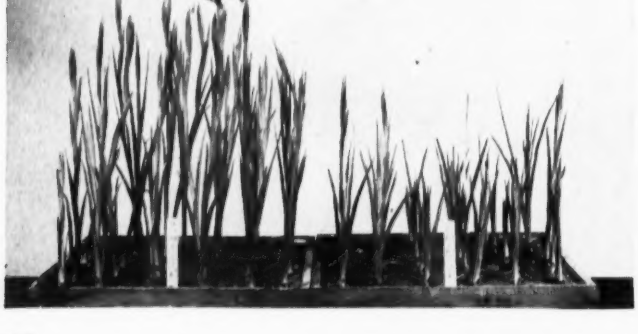
The differences are due to mysterious biochemical changes in the bulb, in the opinion of ARS plant physiologist N. W. Stuart, of the Agricultural Research Center, Beltsville, Md., plant pathologist D. L. Gill, of the Coastal Plain Experiment Station, Tifton, Ga., and Washington Agricultural Experiment Station plant pathologist C. J. Gould, of the Puyallup Branch. They don't know precisely what the changes are but have learned some helpful things to do.

The tulip is a notoriously poor bloomer in the South. When handled wrongly before planting, this plant may bloom late and on very short stems. The bulb must be kept at room temperature for the first few weeks after digging, to develop flowers. If it then has about 6 weeks at the cool temperature of 40° or 45° F. in storage, followed by 4 to 6 weeks at 48° or 50° F. in a household refrigerator or in the ground, the resulting plant will produce long stems and bloom profusely in 1 to 2 months.

Easter lily bulbs need to be held 6 weeks at 45° or 50° F. just prior to planting, to bloom early. But keeping them at 31° to 33° F. for that period will cause later blooming.

Dutch iris bulbs for greenhouse forcing, on the other hand, need humid heat-curing at about 90° F. for 10 days and then storage at about 50° F. for 6 weeks. Bulbs planted then (around October 15) will bloom well in December and January. ☆

HEAT CURING iris bulbs at left for 10 days at 90° F., then storing at 50° F. until planted, brought them into bloom long before iris at right, which was stored at 50° F. for entire period.



TULIP BULBS at left, stored at 40° F. from mid-September through October and 50° F. until planted late in November, bloomed early on long stems. Others stored at 50° F. bloomed late on short stems.

Improved cottonseed meal

Large quantities of improved cottonseed meal are now being used in poultry rations, thanks to better processing methods based on research by USDA and cooperators. Some 250,000 to 500,000 tons went into broiler and chick rations last year.

The processing involves carefully controlled heating and pressing of the raw cottonseed. Much free gossypol (yellow pigment) is removed, but high protein quality is maintained.

ARS and State experiment station researchers showed that chick and broiler rations with equal amounts of improved cottonseed and soybean meals produce the same growth and feed efficiency as soybean meal alone.

Commercial cottonseed meals produced by the improved methods are now being put into mixed feeds and fed to poultry other than laying hens. Researchers are working to produce a meal to feed to laying hens without adversely affecting egg quality.

Tests at the North Carolina Agricultural Experiment Station showed that calves fed a diet with 40 percent of the new meal suffered no ill effects. Researchers are investigating the use of improved cottonseed meal in milk substitutes for calves. Other work has also shown that up to 20 percent of the meal can be added to the diet of pigs over 8 weeks of age without causing them any noticeable harm.

Vermont certified

Vermont has been declared modified-certified brucellosis free—the ninth State so far and fourth this year so certified. That means not more than 1 percent of Vermont's cattle and not more than 5 percent of the State's herds have brucellosis. Other certified States include Connecticut, Delaware, Maine, New Hampshire, North Carolina, Wisconsin, Minnesota, and Washington. Also 453 counties in 26 other States and Puerto Rico have achieved similar status.

Anniversary at Geneva

Cornell University's New York State Agricultural Experiment Station, at Geneva, recently celebrated the 75th anniversary of its founding with a symposium on "The Role of Agriculture in Future Society."

Speakers included Governor Averell Harriman; Willard F. Libby, Atomic Energy Commission; Arthur J. Heinicke, station director; Byron T. Shaw, ARS administrator; and educational and industrial leaders.

The 600-acre station, which began operation in March 1882, is especially well known for work in developing new fruit and vegetable varieties for processing. This station was among the first six agricultural research institutions in the country established with publicly appropriated moneys.

Ground-breaking ceremonies for a new food science building were held. New facilities for insect and plant-disease research are being planned.

New research facilities

New USDA research facilities for work on soil and water conservation and wool processing will be built with funds recently appropriated.

The United States Sedimentation Research Laboratory, Oxford, Miss., will be used to study hydraulics of sediment transport. The Southern Piedmont Conservation Field Station, Watkinsville, Ga., will study systems of soil management. The Southwestern Soil and Water Research Laboratory, Phoenix, Ariz., will deal with efficiency of water use in irrigated valleys of the arid Southwest. The North Central Conservation Field Station, Morris, Minn., will study new soil and water management systems.

A pilot plant will be built at the ARS Western Utilization Research and Development Division, Albany, Calif., for study of new wool-processing methods at every stage from grease wool to the woven fabrics.

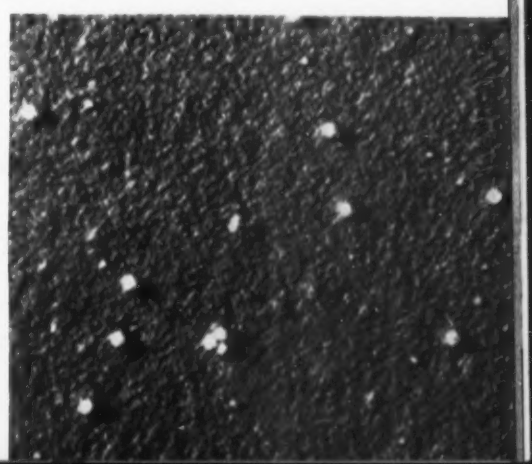
Foot-and-mouth virus seen

The virus causing foot-and-mouth disease—of great economic importance to livestock production the world over—has been purified, isolated, and photographed for the first time at USDA's Plum Island Animal Disease Laboratory (Agr. Res., September 1956, pp. 7–10).

Electron micrographs of the virus (pictured below) show it's spherical and about one-millionth inch in diameter. It's the smallest yet seen of the viruses affecting animals—even smaller than the polio virus.

Knowing more about the physical makeup of the foot-and-mouth disease virus will help speed research on the development of new and effective means of fighting the disease.

ARS scientists H. L. Bachrach and S. S. Breese, Jr., announced this accomplishment at the fall meeting of



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the Electron Microscope Society of America, at Cambridge, Mass.

Gamma ray vs. fruit fly

A sealed radioactive-cobalt unit recently installed in USDA's Fruit Fly Research Laboratory at the University of Hawaii, Honolulu, may answer two important questions: Can we use highly penetrating gamma rays to kill or render harmless fruit flies concealed within fruits or vegetables so they can be shipped beyond quarantine? And can we use gamma rays to eradicate or thin out fruit flies by sterilizing and releasing males to thwart reproduction, as we did with screwworm flies on Curacao Island?

The 400-curie cobalt-60 unit has a "hot" chamber large enough to treat fruit as big as papayas or mangoes, or immature fruit flies by the thousands. The unit was built specifically for this type of fruit-fly research.

New vitamin A source

A fermentation process for production of beta-carotene—widely used in livestock and poultry feeds as a source of vitamin A—has been developed by USDA. The new process utilizes a technique for mating specially selected microbes. It is now undergoing further development at the ARS Northern Utilization Research and Development Division, Peoria, Ill.

Carotene—from plants or synthesized chemically—provides vitamin A needed by all animals. Carotenes and related carotenoid pigments produce desirable yellow-orange color in poultry tissues, eggs, dairy products, and beef fat. And they are also used to color foods containing fats and oils—such foodstuffs as shortenings, dairy products, and pastries.

Mold fungi of the Choanephoraceae family will grow in solutions of ground corn and other cereals in aerated fermenters and create deposits of beta-carotene in the fungus cells. The West Virginia Agricultural Experiment Station discovered that mating of strains of the mold *Choanephora cucurbitarum* increases the yield of fermentation products. A team headed by R. F. Anderson at the Peoria laboratory worked with *C. cucurbitarum* and related species and obtained a 4-fold to 5-fold increase in carotene yield by using two mated strains of the molds (shown by dark stripe on the plant culture pictured below), and further large increases by improving the culture medium.

Carotene that is stored in the fungus cells can be concentrated for filtration. The resulting product is a bright-orange filter cake or mat of solids containing up to 0.5 percent beta-carotene. It may be ground for use in feeds or processed to obtain pure beta-carotene. Assays have shown that beta-carotene produced in this way is biologically available.

Promising corn starch

A new type of dent corn having a high content of amylose—a valuable starch ingredient—shows promise for many important industrial uses.

Starch from this corn has as much as 80 percent amylose compared to 25 percent in ordinary cornstarch. High-amylose starch is useful because it gels easily owing to its fiber-like molecular structure. It can be made into durable fibers, plastics, and transparent films—for example, a dip or spray coating to preserve irregularly shaped foods or products.

Starch containing mostly amylopectin—the other major starch constituent—normally won't gel because of its different molecular structure. Such starch has many uses, however: for textile and paper sizing, adhesives, oil-well drilling muds, a variety of food and industrial uses—but *not* for plastics, films, or fibers.

Among high-amylose corn hybrids developed by USDA-State researchers, the highest are lacking in productivity. But some strains with up to 60 percent amylose and typical dent-corn ears and kernels look promising. These are being analyzed at the ARS Northern Utilization Research and Development Division, Peoria, Ill.

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